

**STATUS OF MINERAL RESOURCE INFORMATION FOR THE
ALAMO INDIAN RESERVATION, NEW MEXICO**

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SUMMARY AND CONCLUSIONS

Mineral resources known to occur on the Alamo Indian Reservation include coal, sand and gravel and stone; uranium and oil or gas also may be present. No commercial production of any mineral has occurred on the reservation.

Coal and uranium have been produced in adjacent areas, and subeconomic quantities of copper, lead, and barite are also found nearby but off the reservation.

Energy resources offer the greatest potential for exploration and development on Alamo Reservation lands. The reservation has been explored for oil and gas using geophysical techniques, but no drilling has been done. Future oil and gas lease sales could encourage private exploration efforts. Detailed information on coal and uranium is lacking, and field investigations would be necessary before the development potential of these minerals can be adequately assessed.

INTRODUCTION

This report was prepared for the Department of the Interior's Bureau of Indian Affairs (BIA) Geological Survey (USGS) and Bureau of Mines (USBM), under an interagency agreement to compile and summarize available information on the geology, mineral resources, and potential for economic development of certain Indian lands. Sources included published and unpublished materials and personal communications. There was no fieldwork.

The Alamo Reservation is located in northwestern Socorro County in central New Mexico ([Figure 1](#)). Access to the reservation is provided by State Highway 52. The town of Magdalena is approximately 18 road miles to the southeast via New Mexico 52. Socorro, the nearest service center (population 4,687) and location of the nearest railhead, lies about 47 miles to the southeast via U.S. 60 and New Mexico 52. Within the reservation, access to State Highway 52 is provided by BIA roads.

The reservation encompasses about 63,109 acres (see [Figure 1](#)); approximately 43,335 acres are tribally owned and approximately 19,774 acres are allotted (U.S. Department of Commerce, 1974, p. 344). The Department of Commerce (1974, p. 344) lists the population of the reservation as 948.

Mineral rights on the reservation are held by various interests. The Alamo Band (Navajo) holds mineral rights on at least 2,080 acres, and the rights on a minimum of 18,016 acres are held by allottees. Mineral ownership on the remaining acreage (43,013) is indefinite or is held-by non-Indian interests, of which the Santa Fe Railroad is probably the largest.

MAP SOURCES

U.S. Geological Survey topographic quadrangle maps are available for the reservation. All the area has been mapped on a 7½-minute, 1:24,000 scale (see [Figure 2](#)). Topographic maps may be purchased from the U.S. Geological Survey, Branch of Distribution, Central Region, Box 25286, Denver Federal Center, Denver, Colo.

80225; they are also sold over the counter by a number of private dealers in New Mexico.

Geologic map coverage for the reservation is available from both the New Mexico Bureau of Mines and Mineral Resources at Socorro, N. Mex. 87801 and the USGS. Maps may be purchased singly or as part of various publications distributed by both agencies.

Another source of map coverage is the U.S. Bureau of Land Management, which has published both land status title plats and land status quadrangles. Both series of maps can be ordered from the Bureau of Land Management, Records Section, P. O. Box 1449, Santa Fe, N. Mex. An index can be obtained to accompany the master title plats. The quadrangles, master title plats, and indexes should be ordered by township and range.

The New Mexico State Highway Department distributes county road maps. Requests should be addressed to the New Mexico State Highway Department, Duplicating Services, P. O. Box 1149, Santa Fe, N. Mex. 87503.

Aerial photographs of the reservation may be purchased from the USGS, U.S. Forest Service, and the U.S. Soil Conservation Service. Satellite imagery can be obtained from the U.S. Geological Survey, EROS Data Center, Sioux Falls, S. Dak.

CONTINUING STUDIES

A number of energy mineral resource studies are being conducted in the vicinity of the Alamo Reservation. When completed, the studies will be important sources of more detailed information on the energy resource potential of the reservation.

As part of the National Uranium Resource Evaluation program, the Department of Energy has awarded a contract to the U.S. Geological Survey for an evaluation of the uranium potential of the Socorro NTMS quadrangle, an area which includes the Alamo Reservation. The study is nearing completion, and an administrative report is scheduled for submission to the Department of Energy in January 1980.

The New Mexico Bureau of Mines and Mineral Resources has recently published an open file report (Chapin, 1979) titled Uranium, oil, and gas potential of the Riley-Puertecito area, Socorro County, New Mexico, and is currently conducting a study of the energy mineral resource potential of the Riley-Alamo Reservation area. Both field areas encompass parts of the reservation.

PHYSIOGRAPHY

The Alamo Reservation is situated at the junction of three major physiographic provinces: the southern part of the Acoma basin or embayment of the San Juan basin (which is part of the Colorado Plateau), the northeastern part of the Datil-Mogollon volcanic field, and the western edge of the Rio Grande trench (part of the Basin and Range province). The area is one of broad flat valleys and small mesas and hogbacks, with the major streams incised into the valleys. High basalt-capped mesas occur in the northwestern part of the reservation. Local relief ranges from about 900 feet on the high mesas to 100 feet or less on the small mesas and hogbacks. The streams are incised 20 to 100 feet.

GENERAL GEOLOGY

The rocks in the region are mostly sandstone and shale, capped on the high mesas by basaltic lava flows. The oldest sedimentary rocks are upper Triassic, about 200 m.y. (million years) old, covered above a profound angular unconformity by Upper Cretaceous rocks about 100 m.y. Volcanic rocks in the southwestern part of the area, latite and rhyolite tuffs and flows, are about 32 m.y. old. The basalt caps are about 3 m.y. old. Much of the area is covered by surficial material ranging in age from about 1 m.y. (terrace deposits) to yesterday's sand and silt.

Sedimentary rock units in the area dip generally toward the south and west, but numerous folds and faults may cause local dips to be in any direction.

The distribution of the rock units, major folds, and faults on the Alamo Reservation and surrounding areas are shown on the generalized geologic map (Figure 3). A generalized composite outcrop section of lower Upper Cretaceous rocks at Puertecito is shown in Figure 4. (Hook and Cobban, 1979.)

Stratigraphy

Chinle Formation.--The Chinle Formation is the oldest rock unit exposed in the Alamo Reservation area. It is about 1,000 feet thick, composed of variegated red, purple, and gray shale with lenses of mudstone, sandstone, and conglomerate. It is soft and easily eroded; outcrops form a characteristic badlands topography or broad flatlands covered by a thin veneer of colluvial material. The resistant

lenses and beds form irregular mesas or hogbacks around shallow folds.

Dakota Sandstone and Mancos Shale, shown as one undivided unit on the geologic map (Figure 3), comprise the following units from oldest to youngest: the basal Oak Canyon Member of the Dakota Sandstone, the lower shale tongue of the Mancos Shale, the Twowells Tongue of the Dakota Sandstone, the middle shale tongue, the Tres Hermanos Member, and the D-Cross Tongue of the Mancos Shale.

Dakota Sandstone

Oak Canyon Member.--The Oak Canyon Member of the Dakota Sandstone in the Alamo Reservation area is composed of about 17 feet of sandstone, overlain by about 50 feet of shale and sandstone. The sandstone is carbonaceous, fine-grained, silty, clayey, soft, poorly bedded, locally crossbedded. The shale is gray, silty, sandy, locally calcareous, with discontinuous thin lenses of bentonite.

Twowells Tongue.--The Twowells Tongue of the Dakota Sandstone is composed of silty, fine-grained, calcareous sandstone that weathers to a pale yellowish gray, with brown weathering limestone concretions in the middle part.

Mancos Shale

Lower Shale Tongue.--The lower tongue of the Mancos Shale, between the Oak Canyon Member and the Twowells Tongue of the Dakota Sandstone, is composed of light-to dark-gray clayey

bentonitic shale, locally silty, sandy, or calcareous, about 200 feet thick.

Middle Shale Tongue.--The middle shale tongue is composed of dark-gray bentonitic shale about 220 feet thick, slightly calcareous in the lower 30 feet.

Tres Hermanos Member.--The Tres Hermanos Member of the Mancos Shale is composed generally of two sandstone beds separated by a shale unit. In the Alamo area the basal 20 feet is composed of thin silty sandstone and sandy shale beds; overlain by a massive cliff-forming sandstone about 130 feet thick, with numerous fossiliferous brown weathering limestone concretions in the lower 20-30 feet. The middle shale unit is about 70 feet thick, pale yellowish gray, silty and sandy. The upper sandstone is about 20 feet thick.

D-Cross Tongue.--The D-Cross Tongue, about 80 feet thick, is composed of light to dark gray shale, locally calcareous with numerous small fossiliferous limestone concretions; a discontinuous limestone bed occurs near the base.

Mesaverde Group

Gallup Sandstone, Gallego Member.--The Gallego Member is the only unit of the Gallup Sandstone present in the area. It is about 60 feet thick, composed of massive fine-grained sandstone. A few miles northwest of the area of [Figure 3](#), the Gallego is overlain by a shale unit and the main sandstone member of the Gallup, overlain in turn by the Dilco Coal Member of the Crevasse

Canyon Formation. The shale unit and the main Gallup pinches out and the Dilco, or an equivalent coal bearing unit, rests directly on the Gallego in the Alamo Reservation area.

Crevasse Canyon Formation.--The Crevasse Canyon Formation in the area of the Alamo Reservation is composed of more than 600 feet of interbedded sandstone, siltstone, and shale. The basal part of the formation, the Dilco Coal Member, is composed of yellowish-gray, irregularly-bedded, poorly-cemented sandstone and siltstone with interbedded carbonaceous shale and coal beds.

Tertiary Units

Baca Formation.--The Baca Formation, about 680 feet thick, is composed mostly of red sandy mudstone with interbedded coarse conglomerate, white and green sandstone, red claystone, and arkosic sandstone.

Datil Formation.--The Datil Formation is composed of a thick sequence of largely volcanic rocks, quartz latite in the lower part, grading upward into rhyolite in the upper part, with locally interbedded lenses of conglomerate, sandstone and siltstone. The quartz latite has been named the Spears Formation and the rhyolite named the Hells Mesa Formation (Tonking, 1957). The Hell's Mesa, 32 m.y. old, is present in the southwestern part of the map area and along the eastern boundary, where it is overlain by the La Jara Peak member, composed of basalt and andesite (Tonking, 1957).

Santa Fe Formation.--The Santa Fe Formation in the map area consists of white, pink, and pale brown conglomeratic sandstones and siltstones composed principally of detrital volcanic material, with local thin beds of rhyolite tuff and basalt flows.

Tertiary Gravel and Sand Deposits.--Gravel and sand deposits composed of clasts of Datil Formation in a groundmass of sand and silt occur along the western edge of the map area and are interbedded with the basalt flows on Tres Hermanos Mesa. They may be part of the Santa Fe Formation but appear to be younger river channel deposits, probably Pliocene in age.

Basalt Flows.--Table Mesa, Tres Hermanos Mesa and Mesa del Oro are capped by porphyritic olivine basalt flows, with megascopic phenocrysts of augite, olivine, and plagioclase. The Mesa del Oro flows are about 3.1 m.y. old (Bachman and Mehner, 1978).

Quaternary Units

Pediment and Terrace Deposits.--Unconsolidated gravel deposits composed primarily of fragments from the Datil Formation occur at numerous localities in the southern part of the map area; only the largest are shown on [Figure 3](#). Most of these deposits are approximately horizontal, and are probably remnants of a once continuous surface. A few gravel deposits occur on terraces along the Rio Salada.

Landslide and Talus Deposits.--Landslides occur in most parts of the map area where resistant beds, basalt or sandstone, overlie incompetent rocks such as the Chinle shales or Mancos Shale. The largest landslide areas are shown on [Figure 3](#). Notable is the large landslide area on the south side of Mesa del Oro, more than 15 square miles. Talus debris also occurs on most hillsides and form deposits around the volcanic necks in the area, especially around the Tres Hermanos.

Spring Deposits.--Recent spring deposits in the area are composed of travertine and gypsum, commonly with included sand grains or rock fragments. Most such springs are now inactive.

Alluvium.--Only the most significant deposits are shown on [Figure 3](#). Most drainage channels, stream beds, and valleys are covered with sand, silt, and clay derived from weathering of the rocks. Includes some colluvial material and soil, especially in areas underlain by Mancos Shale.

Intrusive Rocks

The igneous rocks, which intrude all the sedimentary and volcanic rocks in the area, are represented by sills, dikes, plugs, and volcanic necks. Only the most prominent are shown on [Figure 3](#). Most of the intrusives are basaltic in composition, but those in the northeastern part of the map area are syenodiorite. Some of the basalts are relatively fresh and unaltered, but most intrusives are deeply weathered and altered. The basaltic intrusives are greenish gray or dark gray to black, with aphanitic groundmass and megascopic phenocrysts of oliv-

ine, augite, biotite, and hornblende. The syenodiorite is speckled green, greenish-gray, gray, and black, aphanitic, with locally conspicuous biotite phenocrysts.

Structure

Sedimentary rocks in the area around the Alamo Reservation dip generally toward the south and west but strikes and dips are modified locally by numerous small north and northwest trending folds and faults. Some representative dips and more prominent folds are shown on [Figure 3](#). Only the major faults are shown, innumerable smaller ones occur, especially in the eastern part of the reservation. The prominent zone of faulting along the eastern side of the area is the northern extension of a major fault system that continues for some seventy miles to the south, with several areas of significant mineralization along it. The old Amy and Abbey districts adjoin the reservation on the south.

Economic Geology

Few data are available on mineral occurrences or resources in the area of the Alamo Reservation. Several localities south of the reservation however, have reported occurrences or deposits of base and precious metals in veins associated with the fault zones that extend into the southern and eastern parts of the reservation. The host rocks for the deposits are primarily limestone or andesite; the other rocks in the region generally have only sparse mineralization and minor occurrences. The Council Rock and Silver Hill mining districts are 8 and

10 miles south of the reservation and the Amy (or Spring Hill) and Abbey districts are adjacent to the south and southeast boundaries of the reservation. An unrecorded but probably considerable amount of silver and lead was produced from the Council Rock district. Silver, lead, and copper was produced in the Silver Hill (or North Magdalena) district. Prospects but no production have been reported from the Amy and Abbey districts for uranium, copper, lead, and barite. Mineral occurrences and the geologic structures present in the reservation suggest the possibility of some potential for mineral resources at depth in the more favorable lithologies along the major faults.

The carbonaceous units in the Baca Formation, especially those associated with coarse grained permeable units, are potential host rocks for uranium deposits. Several occurrences in such rocks have been reported on and around the reservation, in brownish- and greenish-white altered zones.

MINERAL RESOURCES

General

Mineral resources that occur on the Alamo Reservation include coal, sand and gravel, and stone. Uranium and oil and gas may also be present. Minor mineral occurrences in areas adjacent to the reservation include barite, copper and lead.

Energy Resources

Energy resources that are or may be present on the reservation include coal, oil and gas, and uranium ([Figure 5](#)). Coal and uranium have been

mined on a small scale southeast of the reservation. Gas has been detected in one exploratory well north of the reservation, and exploration efforts for oil and gas in the area are continuing.

Coal

The Datil Mountain coalfield, New Mexico's least accessible coal bearing area, underlies much of the Alamo Reservation. The coal occurs in the Cretaceous Mesa Verde Group rocks, which crop out over a 47-square-mile area of the reservation

(Figure 3). The area of outcrop defines the boundary of the Datil Mountain coalfield. South of the Mesa Verde outcrop, as many as 27 additional square miles in the southwestern corner of the reservation may be underlain by coal-bearing rocks.

Coal-bearing beds range from 2½ to 4½ feet thick and contain 2½ to 3½ feet (Osgood, 1936, p. 107) of low sulfur, bituminous to subbituminous coal. Analyses showing the characteristics of seven coal samples taken from workings on or near the reservation are listed in Table 1.

TABLE 1
Analyses of Seven Coal Samples From the Datil Mountain Coalfield in the Alamo Reservation Area
(See Figure 5)

Name/Location (sec., T. R.)	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	BTU/lb	Source
Hot Spot(s) mine NW¼ 18, 1 N., 5 W.	6.6	32.8	54.2	6.4	0.5	11,555	Tabet and Frost, 1978
unnamed prospect 18, 1N., 5 W.	6.5	34.5	51.9	7.1	0.5	11,990	Fieldner, Cooper and Osgood, 1936, p.62
	---	36.9	55.5	7.6	0.5	12,820	
	---	39.9	60.1	---	0.6	13,870	
unnamed prospect 8, 2N., 6 W.	25.9	30.3	34.7	9.1	0.4	7,430	Fieldner, Cooper and Osgood, 1936, p.62
	---	40.9	46.9	12.2	0.5	10,030	
	---	46.6	53.4	---	0.6	11,430	

Based on limited geologic information and an arbitrary thickness of three feet, preliminary estimates indicate that 66 million short tons of coal are contained in the Mesa Verde outcrop belt. As much as 90 million additional short tons may be contained in Mesa Verde Group rocks underlying

the 26 sections south of the outcrop belt in the southwestern corner of the reservation. The coal-beds may be lenticular and discontinuous which would have the effect of either decreasing or increasing the estimates.

The coalbeds dip gently to the southwest, and the shallow coal adjacent to the outcrop may be amenable to recovery using strip mining methods. Away from the outcrop, increasing overburden thicknesses would eventually preclude utilization of this cost-effective technique. Because the coal seams are thin, the higher costs of underground mining would probably make the deeper deposits subeconomic and mining impractical.

In summary, because definitive information is not available, resource estimates are of limited value. Without a detailed field examination, it is impossible to determine if reserves are sufficient to sustain a mining operation.

Oil and Gas

The Alamo Reservation lies within the southern extension of a petroleum exploration area known as the Acoma basin. Foster and Grant (1974) indicate that the basin is one of the more favorable exploration areas in the State: Permian and Pennsylvanian rocks are thought to be excellent reservoir rocks, and fault and anticlinal structures good exploration targets.

Several oil and gas exploration wells ranging from 4,012 to 9,400 feet in depth have been drilled on adjoining lands around the reservation. One well, the Spaniel-Heinze I-F Santa Fe Pacific No. 9608, drilled during 1959 on the west flank of the Lawson anticline in sec. 17, T. 4 N., R. 5 W., north of the reservation, reported a gas show in Pennsylvanian rocks (Sandia Formation) at a depth of 4,242 to 4,297 feet (Petroleum Information Corp.). Red Lake No. 1, in sec. 2, T. 3 N., R. 8 W. was drilled in 1925 and abandoned in 1931, and the

Ohio Oil Co. McDonald No. 1, in sec. 32, T. 4 N., R. 6 W. was drilled in 1926 and converted to a water well in 1931 (N. M. Geol. Soc. 1963). The records for the remaining two wells, which were drilled by Transocean Oil, Inc., of Houston, Tex., have not been released. Transocean also has conducted a geophysical exploration program on the reservation (Tom Lynch, BIA, personal communication, 1978).

Transocean, probably as a result of its drilling and geophysical efforts, has expressed considerable interest in obtaining oil and gas leases on the reservation and adjoining lands (Tom Lynch, BIA, and Charles E. Chapin, New Mexico Bureau of Mines and Mineral Resources, personal communications, 1978). No oil and gas leases have ever been issued on the reservation. However, the BIA plans to schedule an oil and gas lease sale in the future (Tom Lynch, BIA, personal communication, 1979).

Uranium

Uranium deposits occur at scattered localities in a narrow, 60-mile long, east-west trending belt extending from western Socorro County to eastern Catron County (Griggs, 1954, p. 129; Griggs and Baltz, 1955, p. 211). The mineralization is found in rocks of the (?) Eocene Baca Formation and Cretaceous Mesa Verde Group ([Table 2](#)), a short distance north of where these units are overlain by the rhyolitic tuffaceous rocks of the Datil Formation (?) Hells Mesa Member of Tonking, 1957, p. 29).

TABLE 2
Assay Data for Samples Taken From Uranium Localities in the Alamo Reservation Area
(See [Figure 5](#))

No. (fig. 5)	Name/Location (sec., T., R.)	Formation	U ₃ O ₈ (percent)	Source
1	Hook Ranch (Airborne anomaly 5) 7, 1 N., 5 W.	Mancos Shale (?)	0.02	Hilpert, 1969, p.54
2	Hot Shot (Hot Spot?) W $\frac{1}{2}$ NW $\frac{1}{4}$ 18, 1 N., 5 W.	Baca Formation	0.37	Hilpert, 1969, p.54; Griggs and Baltz, 1955, p.211
3	Hust-McDonald-Brown NE $\frac{1}{4}$ 24, 1 N., 6 W.	Baca Formation	0.22	Hilpert, 1969, p.54; Griggs and Baltz, 1955, p.211
4	Hook(s) Ranch (Jaralosa) SE $\frac{1}{4}$ SW $\frac{1}{4}$ 13, 1 N., 6 W.	Baca Formation	0.16	Hilpert, 1969, p.54; Chenoweth, U.S. Depart- ment of Energy, personal comm., 1978
5	Hogsett-Hust-Henderson 1-4 (Airborne anomalies 2,3) NW $\frac{1}{4}$ 24, 1 N., 6 W.	Baca Formation		Hilpert, 1969, p.54
6	Beal Claims SE $\frac{1}{4}$ NW $\frac{1}{4}$ 26, 1 N., 6 W.	Mancos Shale (?) or Baca Formation (?)	N.A.*	U.S. Atomic Energy Commission 1970, p.192
7	Nicolls-Higgans-Jones SW $\frac{1}{4}$ 2, 1 N., 6 W.	Baca Formation	0.35** 0.48** 0.52**	U.S. Atomic Energy Commission 1970, p.196
8	Unnamed SE $\frac{1}{4}$ NW $\frac{1}{4}$ 9, 1 N., 6 W.	Baca Formation	N.A.*	-----

The belt crosses the Alamo Reservation in Ts. 1 and 2, N., R. 6 W. (Figure 5). In this area, uranium is known to be associated with carbonaceous material contained in white to light gray sandstone beds of the Baca Formation (Griggs, 1954, p. 130). South of the reservation in sec. 13, T. 1 N., R. 6 W., uranium has been recovered at the Hook Ranch (Jaralosa) mine. From 1959 to 1961, 187 tons of ore containing 580 pounds of uranium oxide and 340 pounds of vanadium pentoxide was shipped (William L. Chenoweth, U.S. Department of Energy, personal communication, 1978). The ore was mined using open pit methods. The ore minerals, including carnotite and autunite, were associated with asphaltic material and carbon trash contained in medium to coarse grained arkosic sandstones (Finch, 1967, p. 20). Other anomalous uranium occurrences on or near the reservation are shown on Figure 5, and associated assay data are presented in Table 2.

Hilpert (1969, p. 148) rates the potential for substantial uranium resources in the Baca Formation as fair and the potential for the Mesa Verde Group as poor.

Nonmetallic Mineral Resources

Numerous pediment and stream gravel deposits exist on the reservation. They are useable for fill and road material, but their suitability for aggregate is unknown. The resource is sufficient to meet needs for which it is suited.

Stone

Flagstone quarried from Cretaceous Mesa Verde Group rocks has been utilized in home building on the reservation. The resource is sufficient to meet future local construction needs.

Minor Mineral Occurrences

Northrop (1959, p. 572), File and Northrop (1966, p. 32), and Mardirosian (1971) report the presence of barite, copper, and lead in two minor mining districts on or adjacent to the eastern and southeastern portions of the reservation. The Spring Hill (Amy) district in T. 2 N., R. 5 W., contains a number of copper prospects. File and Northrop (1966, p. 36) indicate that the district is "probably" located in the northwest quarter of the township. The Abbey (Bear Mountain, Bear Springs) district in T. 1 N., R. 5 W., contains a number of barite, copper, and lead prospects. Northrop (1959, p. 512) implies that this district is located in the vicinity of Abbey Springs in the northwest quarter of the township. Information on the two districts is sparse and their exact locations are in question. No production records could be located. Development apparently never proceeded beyond the prospecting stage.

Although no detailed information is available, the geology and mode of occurrence of the minerals in the districts may be similar to that of better known areas in the State. In the Abbey district, minor copper mineralization is present in the Cretaceous Dakota Sandstone (Charles E. Chapin, New Mexico Bureau of Mines and Mineral Resources, personal communication, 1978). Mineral-

ization also may be associated with the Datil volcanics. Williams, Fillo, and Bloom (1964, p. 30) identified such an association in the North Magdalena mining district southeast of the reservation where barite, lead, and zinc occur in andesitic volcanics. In the Spring Hill district, copper could be associated with the Dakota Sandstone or with the "red-beds" of the Triassic Chinle Formation (Soule, 1956, p. 16).

RECOMMENDATIONS FOR FURTHER STUDY

The following recommendations are made for future work on the Alamo Reservation:

1. A field examination to determine the location, quality, and quantity of coal in that portion of the Datil Mountain coalfield on the reservation.
2. A field examination to determine if uranium is present in commercial quantities in the Baca Formation and Mesa Verde Group rocks.
3. Further exploration for oil and gas to determine its potential on the reservation.
4. Reconnaissance geochemical prospecting in the southeastern part of the reservation to determine extent and economic potential for base and precious metal deposits.

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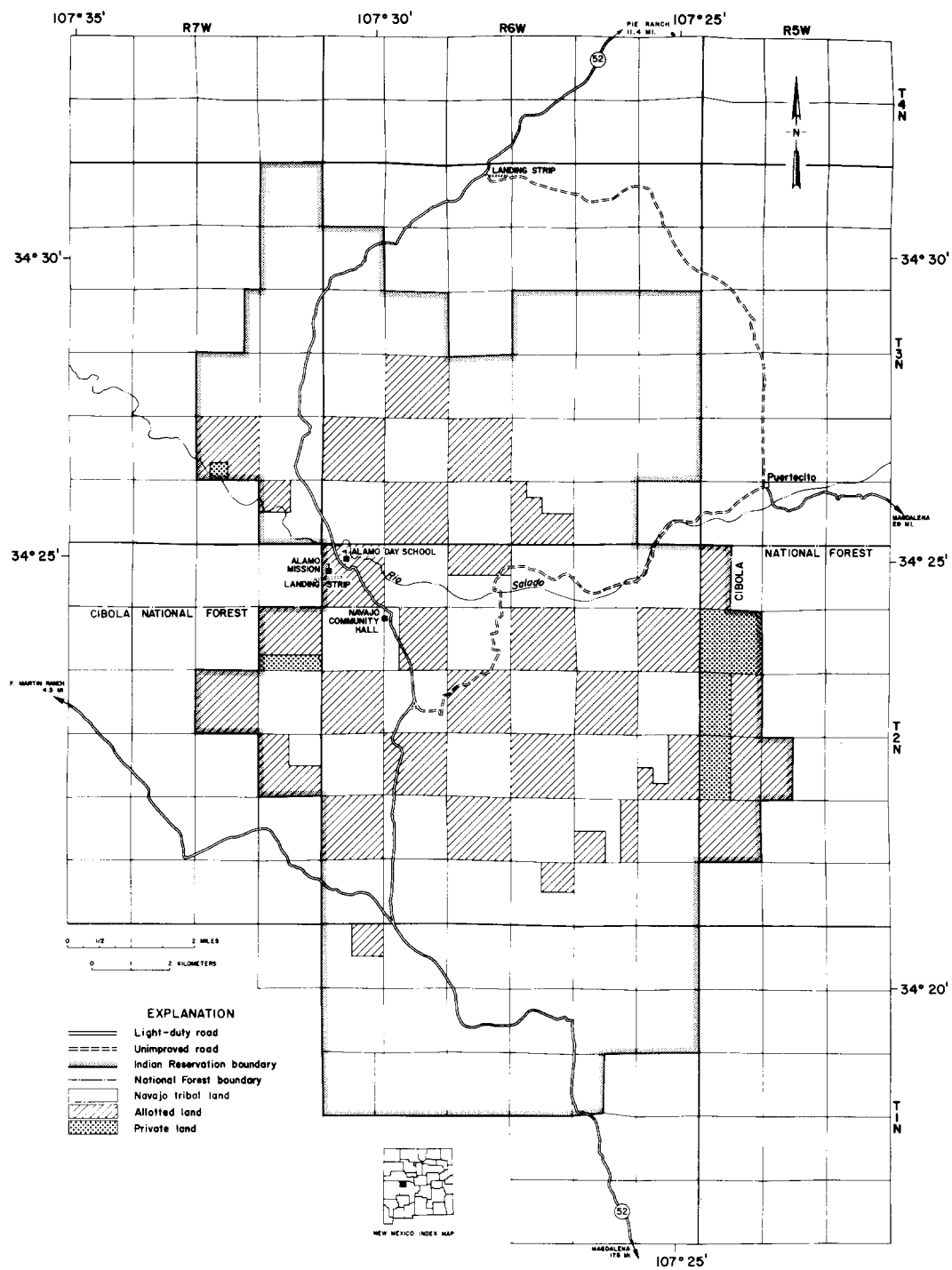


Figure 1. Social features and surface ownership of the Alamo Indian Reservation, Socorro County, N. Mexico.

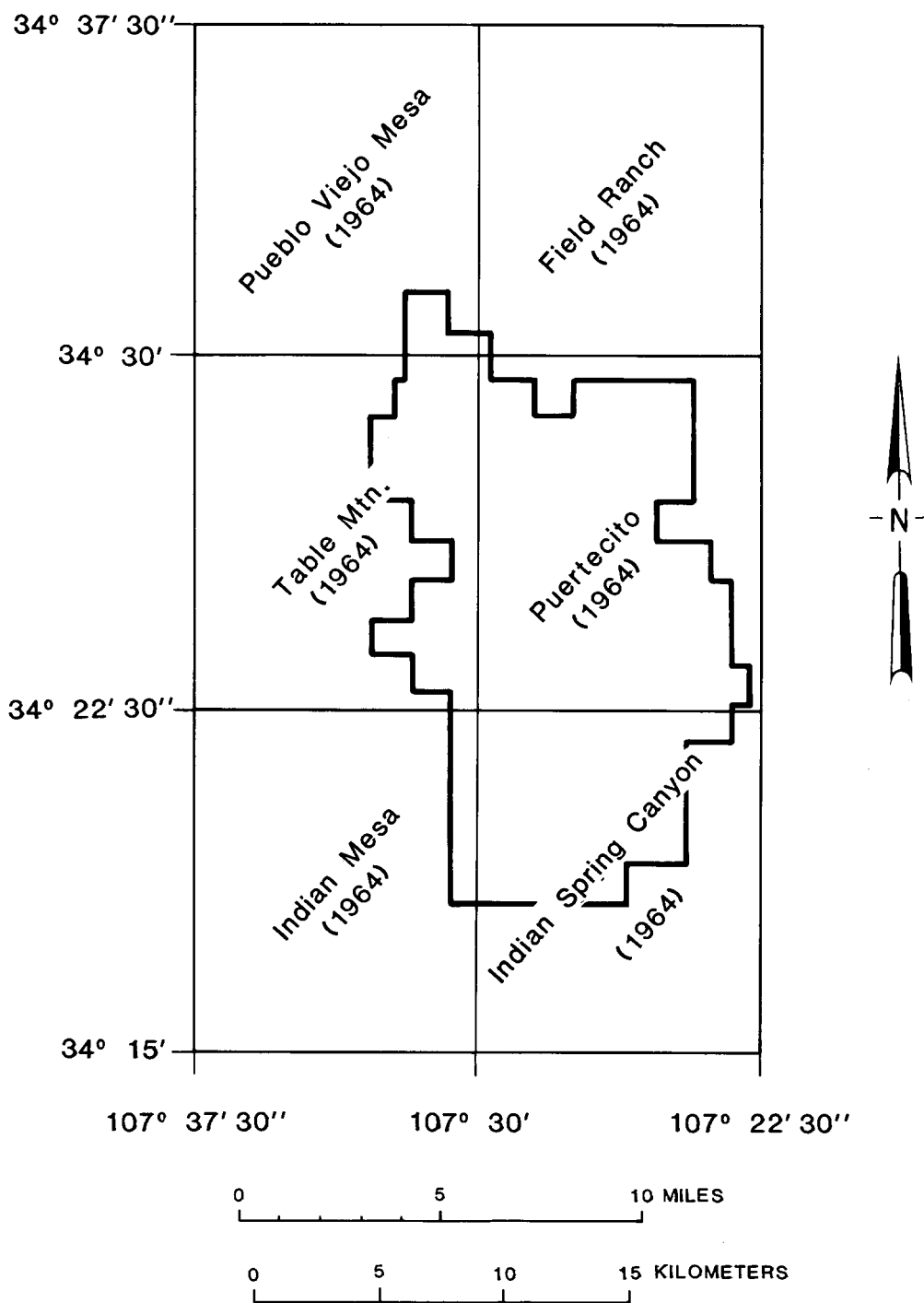


Figure 2. Index to U.S. Geological Survey 7 1/2-minute quadrangle topographic maps for the Alamo Reservation, Socorro County, N. Mex. (pub. dates in parentheses).

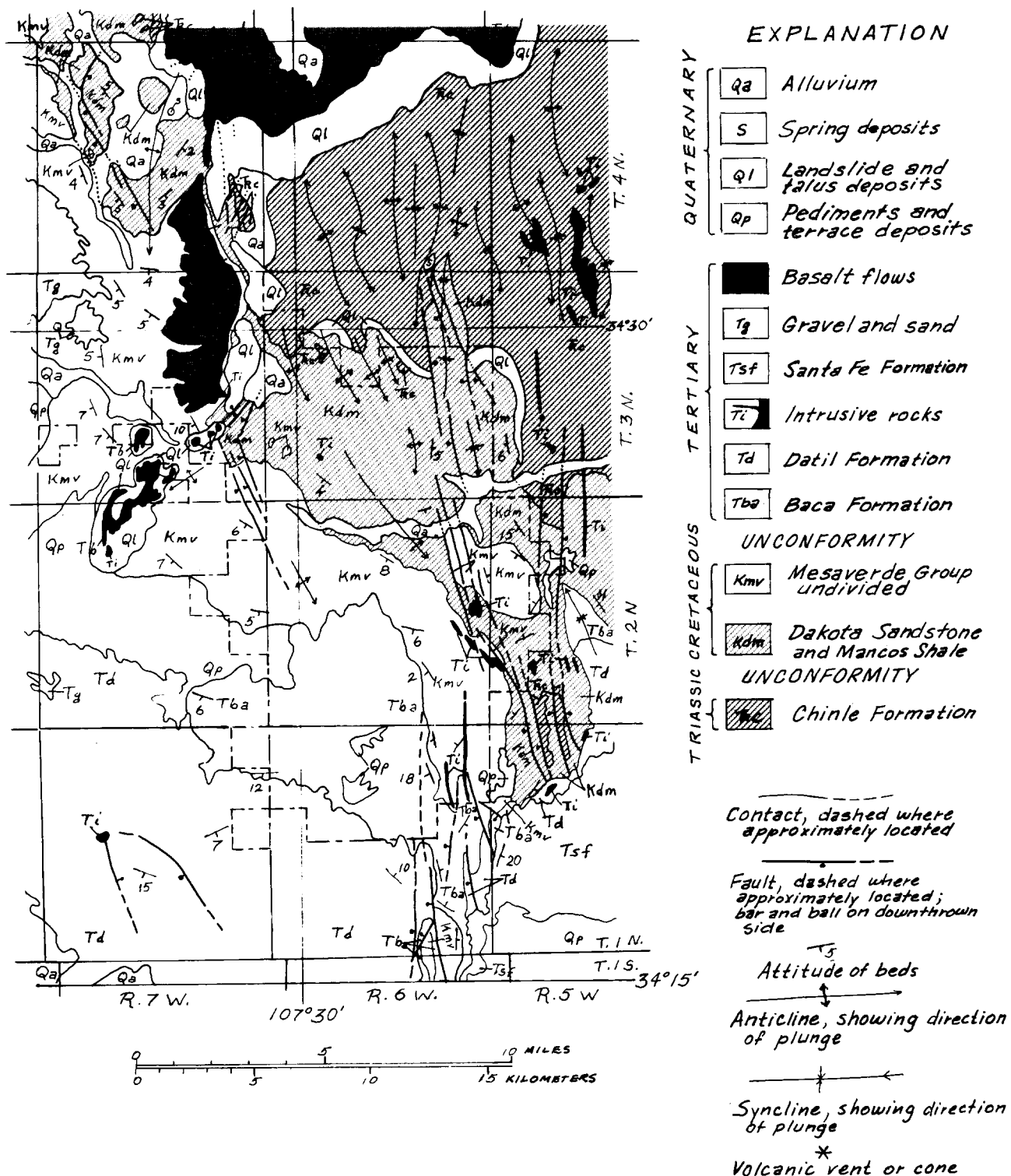


Figure 3. Geological map of the Alamo Indian Reservation and surrounding area, New Mexico.

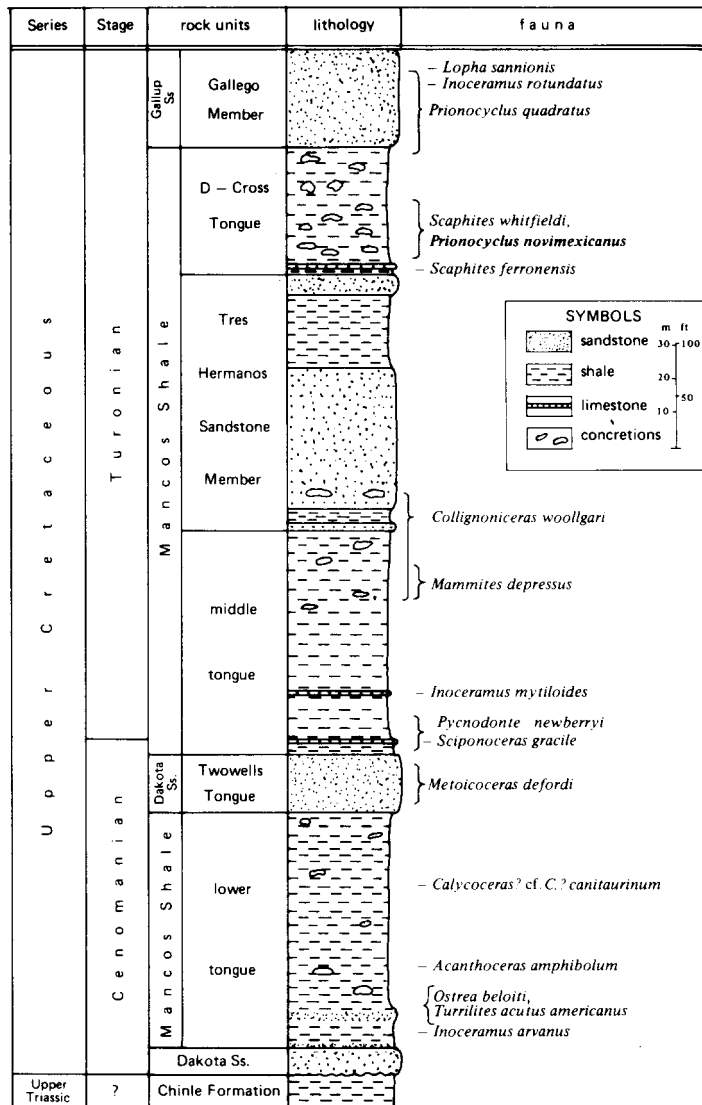


Figure 4. Generalized composite section of lower upper Cretaceous rocks at Puertecito (Hook and Cobban, 1979, p.41).

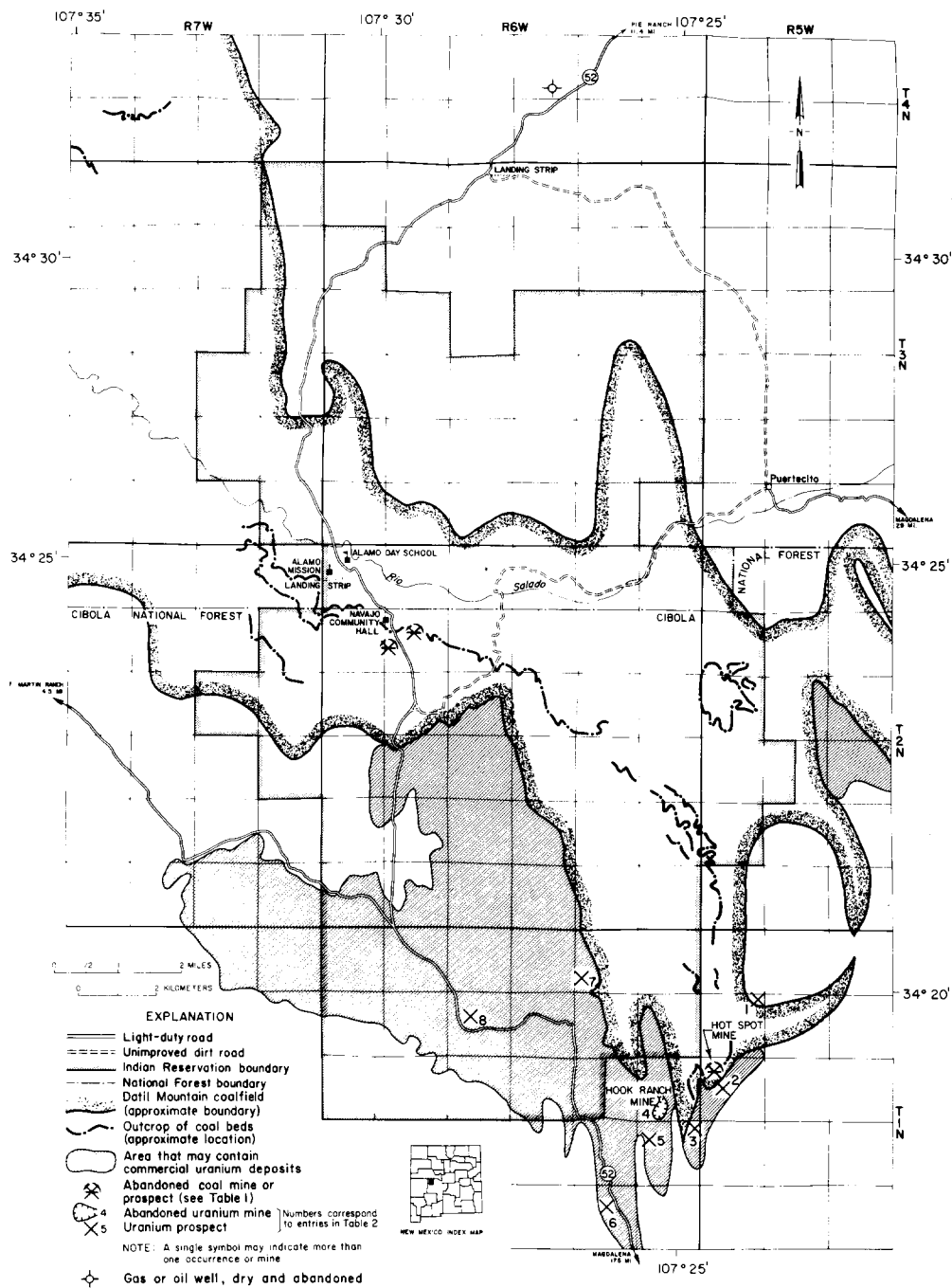


Figure 5. Energy resource map of the Alamo Reservation, Socorro County, N. Mex. (Sources of data: Givens, 1957, p.11; Griggs, 1954, p.130; Griggs and Baltz, 1955, p.211; Hilpert, 1969, p.54; Osgood, 1936, p.107; Petroleum Information; Tabet and Frost, 1978; Tonking 1957, p.23; U.S. Atomic Energy Commission, 1970, p.196; Winchester, 1921, p.8).